Learning Theories Involved in Design of this Project

*For definitions of the learning theories below, please see http://www.learning-theories.com/

There are 4 learning theories that this project has been designed around. They are:

- **Cognitive Apprenticeship Theory** by Collins et al. [Constructivist Theory]
- **Discovery Learning** by Bruner [Constructivist Theory]
- **Problem Based Learning** [Constructivist Theory]
- **ARCS Model of Motivational Design** by Keller [Motivational Theory]

The **Cognitive Apprenticeship Theory** states that people learn from each other through 'observation, imitation and modelling'. Through the use of modelling, coaching, scaffolding, articulation, reflection and exploration, students are able to develop their cognitive and metacognitive strategies for using, managing and discovering knowledge. Students are able to learn from their teacher and from their peers. The entire unit has been designed to engage student's prior knowledge to develop new knowledge. A lot of thought has gone into scaffolding so that students can be successful with the most difficult concepts of the unit (which occur later in the unit). All lesson and activities have been designed to model, coach and scaffold information for the students. Students are given many opportunities to articulate their knowledge, through many different methods and in some cases, have an opportunity to reflect on their knowledge and further explore problems. Almost all of the activities in this unit happen in small groups so that students can learn not only from the teacher, but also from each other.

The **Discovery Learning Theory** states that people learn best when they are able to discover facts and relationships for themselves. Many lessons in this unit are designed by asking a question or several questions and having students find the answer to these questions, whether through internet research, or using the knowledge of the group. For example, asking students how they can increase the rate of dissolving of a sugar cube and allow them to use whatever materials they need to do that. Or by asking students how does ion size and charge affect solubility? These questions provide students an opportunity to discover facts and relationships themselves, whether they perform an experiment, study a simulation or research their answer.

Problem Based Learning is similar to Discovery Learning in that students are given a problem and challenged to come up with a solution. For example, students are asked to determine what ion is present in solution and how they would test for it. There is not necessarily only one right answer, and students will work in a small group to come up with a possible procedure for testing it. Or by asking students to decide whether their solution is a strong acid, weak acid, strong base or weak base and they have access to any materials in the lab to solve their challenge. Again, there is not one right way to solve the problem and they have to work with each other, in a small group, to solve the problem.

ARCS Model of Motivational Design is a motivational theory that promotes and sustains motivation in learning. There four steps to promoting and sustaining motivation are attention, relevance, confidence and satisfaction. In the attention step, Keller states that attention can be gained through surprise and uncertainty or by playing on the student's curiosity, through asking challenging questions or problems to be solved. In the second step, relevance must be established to increase a student's motivation. In the third step, students must feel confident that they can complete the task and understand what is being asked of them. In the last step, students get satisfaction from their learning, perhaps by the use of feedback and reinforcement.

This entire unit has been created to play on the student's curiosity (they are an environmental toxicologist and they have to solve the following problem, or explain why you see layered liquids or what will happen if we mix alcohol and water and why). Many challenging questions have been asked for students to solve throughout the entire lesson (see above). Relevance has been established throughout the unit, by using substances that students use in their own lives, putting them in a real-life situation as an environmental toxicologist or asking them to make solutions for the lab. Because of the thought that has gone into scaffolding the unit, student confidence should be high, as most of these tasks are completed several times throughout the unit, or have been asked of them in previous units. By encouraging students to share their work with the class, through presentations or posting their work on the course website, students have an opportunity to receive feedback from not only their teacher but also their peers.